AGRICULTURAL
LIBRARY

Royal Agricultural Society [redacted]nd.

CONTAGIOUS FOOT ROT

OF

SHEEP.

BY

PROFESSOR SIR GEORGE T. BROWN, C.B.

WITH EIGHT ILLUSTRATIONS.

SECOND AND ENLARGED EDITION.

(All rights reserved.)

London:
JOHN MURRAY, ALBEMARLE STREET.
1905.

Price One Shilling.

PAMPHLETS AND LEAFLETS

ON

VETERINARY SUBJECTS

ISSUED BY

THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

PAMPHLETS.

Obtainable from the Secretary at the Society's House, 13 *Hanover Square, London, W.; or of the Publisher,* Mr. John Murray, 50a *Albemarle Street, London, W.*

THE ANIMALS OF THE FARM IN HEALTH AND DISEASE. By Professor Sir George Brown, C.B. 72 pp. With 52 Illustrations. Third Edition: 1895. Price One Shilling.

DENTITION AS INDICATIVE OF THE AGE OF FARM ANIMALS. By Professor Sir George Brown, C.B. 64 pp. With 60 Illustrations. Fifth Edition: 1902. Price One Shilling.

THE STRUCTURE OF THE HORSE'S FOOT AND THE PRINCIPLES OF SHOEING. By Professor Sir George Brown, C.B. 24 pp. With 12 Illustrations. Fourth and Enlarged Edition: 1902. Price Sixpence.

THE MARE AND FOAL. By Professor J. Wortley Axe, M.R.C.V.S. 58 pp. With 20 Illustrations. 1898. Price One Shilling.

CONTAGIOUS FOOT ROT OF SHEEP. By Professor Sir George Brown, C.B. 24 pp. With 8 Illustrations. Second and Enlarged Edition. 1905. Price One Shilling.

THE LAMBING PEN. By Harold Leeney. 38 pp. With 9 Illustrations. Third Edition: 1897. Price Sixpence.

LEAFLETS, &c.

Copies sent gratis on application to the Secretary at the Society's House. 13 *Hanover Square, London, W.*

TUBERCULOSIS IN DAIRY STOCK. Tuberculous Milk, Symptoms, Tuberculin Test, Means of Checking the Spread of the Disease. March, 1899. (This Leaflet may also be had in the Welsh Language.)

PREVENTION OF EPIZOOTIC ABORTION IN COWS. Causes, Antiseptic Treatment, and Precautions against Infection. Revised April, 1899.

NOTES ON ANTHRAX. Directions for the proper Disposal of Anthrax Carcasses, and Notes on the Anthrax Bacillus. August, 1894.

QUARTER-EVIL. Disposal of Quarter-Evil Carcasses, Disinfectant Precautions, and Symptoms. March, 1899.

NOTES ON MAGGOTS IN SHEEP. By Professor Sir George T. Brown, C.B., and Mr. Cecil Warburton, M.A., F.Z.S., Zoologist to the Society. March, 1903.

GRICULTURAL
LIBRARY

Royal Agricultural Society of England.

CONTAGIOUS FOOT ROT
OF
SHEEP.

BY
PROFESSOR SIR GEORGE T.homas BROWN, C.B.

WITH EIGHT ILLUSTRATIONS.

SECOND AND ENLARGED EDITION.

(All rights reserved.)

London:
JOHN MURRAY, ALBEMARLE STREET.
1905.

SUMMARY OF CONTENTS.

PAGE
INTRODUCTORY 3
VIEWS OF THE OLDER WRITERS 5
GENERAL CHARACTER OF FOOT ROT 6
NON-CONTAGIOUS FOOT ROT 7
PATHOLOGY OF CONTAGIOUS FOOT ROT 9
SYMPTOMS OF CONTAGIOUS FOOT ROT 10
EXPERIMENTS TO TEST THE CONTAGIOUS CHARACTER OF FOOT ROT 14
FURTHER EXPERIMENTS AT HARROW AND DENHAM . . . 15
CONCLUSIONS FROM THE EXPERIMENTS 21
CURE AND PREVENTION OF FOOT ROT 22

619.3
B81c2
Agric. Library

22 Ap 19 Robinson

CONTAGIOUS FOOT ROT OF SHEEP.

INTRODUCTORY.

In revising the pamphlet which was published in 1892 on Contagious Foot Rot of Sheep it is impossible to avoid reference to the public attention which has recently been particularly directed to the subject. The Departmental Committee on Sheep Dipping state in their Report that they have received valuable information upon the disease of foot rot, and suggest that there is need for a further scientific investigation into this very noxious and prevalent complaint, and the National Sheep Breeders' Association have endeavoured to induce the Board of Agriculture to carry out this suggestion. The Council of the Central Chamber of Agriculture have adopted a Report from their Cattle Diseases Committee supporting the recommendation of the Departmental Committee. It would appear, however, that the Board of Agriculture decided not to appoint a Departmental Committee, but instead to test the advantages of treatment by means of a foot bath in which a suitable solution was placed and through which the sheep are walked. A solution of sulphate of copper has been selected for trial, and, by direction of the Board, baths or troughs have been placed on farms in certain parts of the country where the disease is prevalent.

There is no reason to doubt that a solution of sulphate of copper will prove as effective as other styptic and antiseptic preparations have proved, but obviously no particular plan of treatment can throw any light on the cause and nature of foot rot, nor will it answer the question which has been asked repeatedly as to whether or not there are two forms of foot rot —a question which was answered many years ago.

A perusal of the evidence which was given by certain witnesses before the Departmental Committee quite justifies the statement in the Report that they conveyed valuable information upon the disease, but the evidence thus furnished was chiefly of importance in substantiating the views which had been promulgated by practical and scientific observers as to the true character of the malady and the best method of treatment and prevention. One witness in particular deals with a very important point when he asserts that foot rot cannot be cured by hand dressing because it is only applied

ate 3D18 35 Ed 2

§ 4[illegible]86

to the foot rot which can be seen, while the foot rot that is not seen is the more dangerous. Another witness points out that the shepherd never begins to treat rot until he finds that some of the sheep are lame, which means, of course, that the disease is already considerably advanced. Another witness advises careful treatment of the feet by hand dressing in the worst cases, and afterwards by driving the whole flock through the trough. Perhaps the most important statement made by any of the witnesses was one to the effect that a shepherd has no right to have foot rot among his flock, a remark which will be further considered in reference to the prevention of the disease. An Irish witness affirmed that in his country they had not much trouble with foot rot for the reason he suggested that the clute, by which he meant the interdigital space, was much more open in their sheep: and the first stage of the disease could therefore be more easily seen and treated. Nearly all the witnesses used the ordinary dressings employed for sheep scab, such as preparations of arsenic, sulphur and lime, tobacco water, and preparations of carbolic acid and diluted sulphuric acid in proportions of 1 in 40 to 1 in 60.

One old-fashioned form of dressing which was advised consisted of ½ pint of vinegar, 1 oz. of butyr of antimony, 1 oz. of nitric acid, ½ lb. of Armenian bole, 1 oz. of oil of vitriol, 2 oz. of blue stone mixed with lard to make an ointment. The quantity of lard seemed to be left to the shepherd to determine, and if the first application was found to be too strong more lard was to be added. Such powerful caustic dressings were at one time in common use either in the liquid form or made into an ointment. The system adopted was to pare away or tear off the whole of the loose horn from the diseased foot, which commonly meant the entire removal of the horny covering. The exposed and bleeding surface was then coated with the dressing, with the immediate result that the whole of the fluid exudate on the foot was coagulated and formed a complete covering to the exposed and sensitive membrane. This heroic method of treatment was certainly very successful.

The evidence altogether may be taken as expressing the views entertained by practical men in England and parts of the Colonies, New Zealand in particular. Generally, there was an agreement among the witnesses as to the contagious character of the disease.

Referring to the suggestion of the Departmental Committee that a scientific inquiry should be instituted, it may be observed that to add much to our present knowledge such an inquiry must involve long and arduous work. A perusal of the following pages will show that some of the questions recently asked have already been answered.

There is more than one kind of foot rot if the term is to be applied to certain well-marked morbid changes in the foot structure. The disease—in one form the most prevalent—is contagious, as the recorded experiments prove; and certain climatic conditions are specially favourable to the development and spreading of the disease although they do not originate it. Various methods of cure are well known, and, if properly applied, are invariably successful: and the prevention of the malady can be secured by the adoption of the same system which is pursued in dealing with other contagious affections—the exclusion of the virus which is secreted by the feet of diseased sheep. When this exclusive system is in the usual conditions of farming impracticable the ravages of the malady may be reduced to a minimum by the prompt application of remedies and isolation of affected sheep.

VIEWS OF THE OLDER WRITERS.

Ancient writers of husbandry, according to Youatt in his book on the sheep, are silent on the subject of diseases of the feet, which for a long period have been prevalent wherever sheep are found, causing much suffering to the animals and serious loss and great anxiety to the owner. The earliest records which the author above mentioned quotes date back to the fifteenth century, when two French scientists, MM. Estienne and Liebault, published in *La Maison Rustique*, in 1529, an account of a disorder among sheep causing lameness, due, it is suggested, to the animals standing too long on their own manure which induces softening and tenderness of the claws. To cure the malady it was considered necessary to cut off the tip of the decayed horn and apply quick lime; the foot then was to be tied up in a linen cloth for the space of one day, next verdigris (acetate of copper) was to be applied instead of the lime, and so on on alternate days until the hoof was whole and sound. About the same period, in our own country, Fitzherbert wrote on a disease affecting the canal between the claws peculiar to the sheep, known as the interdigital canal, and gave directions for the removal of the part under the impression that it was a species of worm which had taken up its residence in that position. Gervase Markham, in 1613, in his "*Maister-peece*," refers to galled feet and recommends a mixture of pomegranate, alum, and vinegar. Mr. Leste, of Crux Easton, in Hampshire, is credited by Youatt with being the first to describe foot rot as it exists at the present day. The disease, he observes, breaks out between the claws with rottenness or stink, and he directs that the horn should be pared before dressing the part.

In 1749, Ellis, in his book, *The Shepherd's Sure Guide*, describes foot rot as being prevalent all over the country, and especially in the counties round the metropolis. He writes of ewes being attacked and communicating the affection to other sound sheep and the lambs, and also remarks on the meadow becoming so much infected with the virus that the disease was rarely absent. The description justifies a strong suspicion that the malady was the contagious foot rot of the present day, which inflicts so much damage on the flocks in all parts of the world. In the account given by Youatt, foot rot is considered to be the consequence of sheep being put on soft marshy pasture, but he allows that the matter secreted from the diseased feet is of an infectious nature and capable of producing the same malady in healthy sheep. Since Youatt's time, scientists and practical farmers have disputed the existence of an infective matter, while, on the other side, they have affirmed its infectivity in a high degree, and even at the present time the controversy is not ended, nor is it likely to be until the necessity for exact definition is recognised.

GENERAL CHARACTER OF FOOT ROT.

In its developed form foot rot is associated with certain well-known and perfectly defined morbid appearances. Briefly, portions of the hoof are broken away, and what remains of that structure is more or less loose and easily removed. Examination of the membrane of the internal foot will show that the surface is covered with small projecting fibres which are really horn fibres secreted by the papillated membrane of the coronet, but instead of being bound together to form the healthy hoof horn, they are hanging loosely from the vascular membrane, from which they originate. This condition is the result of the inflammation of the formative membrane inducing excessive secretion of horny material and the absence of due pressure to control and consolidate the elements, owing to the loss of the normal hoof. Exactly the same condition of the foot is seen in the early development of the foot of other hoofed animals—the horn fibres of the foot of the fœtus, even up to the time of birth, are loosely aggregated, and end at the bottom or sole of the foot in a pointed tuft of fibres, much resembling a painter's brush which has been dipped in paint and allowed to get partly dry. The morbid condition of the diseased foot in foot rot is merely an exaggeration of the normal function of repair. A great German pathologist is credited with the assertion that in disease no new elements are produced, but the normal elements of the organism are formed in excess, leading to hypertrophy; or they are deficient, causing atrophy; or they are perverted and appear in abnormal positions.

Ordinarily the excessive growth of horn fibres in foot rot is owing probably to its rapidity, described as fungoid. There is no fungus, however, except it be obtained from without, but only epithelial cells and numerous micro-organisms, and it is important to emphasize the fact of identical conditions being present in other diseases of the foot, which are clearly not contagious, but inflammatory, due to ordinary causes which may affect a whole flock exposed to them, and give support to the idea that the spreading of the malady is evidence of contagion. To quote examples, injury to hoof horn by puncture from thorn or nails, overgrowth of the wall of the hoof, allowing the gritty matters of sandy or gravelly soil to be pressed through the pores of the sole into the interior of the foot—in short, anything which excites inflammation in the secreting membrane of the internal foot will be followed by exudation of fluid and separation, more or less complete, between the horn and its formative membrane, ending in excessive deposit of the elements of horn, unchecked by normal pressure—exactly the morbid appearances of contagious foot rot; not in such case consequent on contagium, but primarily the result of injury to the hoof horn.

NON-CONTAGIOUS FOOT ROT.

A remarkable instance of the first form of foot disease beginning in the hoof was met with some years ago in Somerset and Dorset, and the following illustrations will show the changes which were observed.

Three distinct conditions of the horny covering of the foot were seen.

One condition was the decay of the horn at the toe, allowing the passage of particles of sand and dirt through the openings in the shrivelled hoof at the toe into the interior of the foot. See Fig. 1 (1) on page 8.

The second condition was the overlapping of the lower edge of the wall of the hoof, illustrated in Fig. 1 (2), leading to the retention of grit and sand, which, owing to the pressure on the base of the foot in the ordinary course of movement, was driven through the spaces between the horn fibres into the interior of the horny cavity.

A third condition was the existence of a minute fissure in some part of the hoof, commonly at the outer surface of one of the digits, appearing as a dark line on the hoof, sometimes not more than the sixteenth, and rarely more than the eighth of an inch in length, as shown in Fig. 1 (3). The consequence of these changes of structure was exactly the same in each case, *i.e.*, the passage of gritty material into the interior of the horny box, either through the decayed horn at the toe, or through the sole under the overlapping wall of the foot, or through the small fissure in the wall of the hoof, which was the entrance to a crack passing into the foot, as shown in Fig. 2.

In several instances the quantity of sand which had found its way through the minute fissure in the wall and along the tortuous canal marked in Fig. 2 was very large, and similar collections of gritty material were found inside the hoof at the toe, having been pressed through the opening in the decayed hoof horn shown in Fig. 1. Inflammation was the natural result of the irritating action of the gritty matter on the sensitive and highly vascular membrane of the internal foot. Exudation would inevitably follow separation of the hoof from its attachments, excessive growth of horn fibres and fungoid growths, as they are usually called, and, in short, all the characteristics of well-defined foot rot, so far at least as that disease can be diagnosed by the morbid condition of the affected part; and it may be added that all which has been stated of the foot disease common on sandy soils in Somerset is equally true of all the diseases of the foot due to injury from the constituents of the soil, thorns, broken glass, nails, and generally to any agencies which interfere with the integrity of the structure of the hoof, and thus expose the internal tissues to injury. Neither of these affections is in any sense contagious, but the writer does not hesitate to affirm that no one, however comprehensive his knowledge of pathology and practical experience in husbandry may be, can distinguish these non-contagious diseases from contagious foot rot by mere inspection of the morbid appearances. This affirmation was epitomised in a remarkable manner in a court of justice some time ago, when foot-and-mouth disease was very prevalent among sheep and cattle. An action was brought against an owner on account of an alleged breach of regulations. The

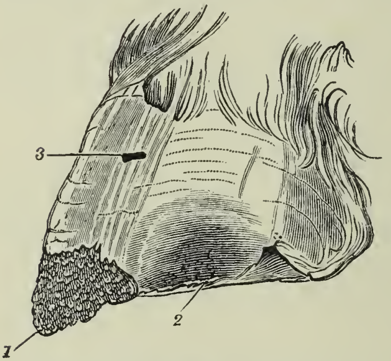

FIG. 1.—Foot of sheep showing decay of horn and minute fissure.

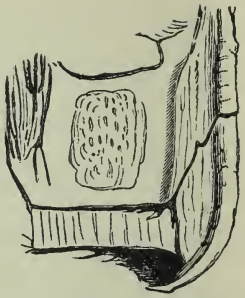

FIG. 2.—Section through the foot showing a crack extending through the wall from the fissure.

defence was that the disease was foot rot and not foot-and-mouth disease. Among the witnesses there were two veterinary surgeons of great experience. To one of them a diseased foot was handed in the witness box, and in reply to a question from the judge the witness said, "I recognise the characteristic appearances of foot-and-mouth disease." The same specimen was handed to the other expert, who replied to the same question, "I notice the distinctive character of foot rot." A more exact acquaintance with the morbid anatomy of the two diseases would have compelled both witnesses to agree in affirming that the appearances were exactly those which were equally characteristic of a diseased foot in foot-and-mouth disease and foot rot in the advanced stages of both disorders. Difficulty in regard to diagnosis would as a matter of course vanish when all the circumstances were known to the examiners conducting an inquiry on the place where either disease was prevalent in a flock of sheep, as in such cases the maladies would be seen in various stages and would be easily differentiated.

PATHOLOGY OF CONTAGIOUS FOOT ROT.

Foot rot may quite correctly be defined as a contagious skin disease, commencing on the integument between the claws, and extending downwards to the internal foot, the vascular membrane of which secretes the horny covering or hoof precisely as the true skin secretes the scarf skin or cuticle. A slight sketch of the structures which constitute the skin will facilitate the understanding of the tissues of the foot which are implicated in the disease. It is a matter of common knowledge that the external covering of the body is composed of at least two layers, which, in common terms, are described as true skin and false skin—the first being constructed of fibrous tissue, with nerves and blood vessels ; the second of cells, at first circular, afterwards becoming flat, as they are pushed up to the surface to form a protecting covering to the vascular and sensitive structure beneath. The flattened cells on the surface are named epithelial or cuticular cells according to their situation. They are illustrated in the ordinary form, as they occur on the surface of the skin and of mucous membrane, in Fig. 5 on page 12.

Proceeding to the description of the foot of hoofed animals, it will suffice to point out the chief features of the organ. The terminal bones of the skeleton form the base, over which fibrous tissue is reflected, with the nerves and blood vessels added, as in the true skin covering other parts of the body. The true skin is extended over the foot, and its vessels secrete cuticle or epithelium, only the cuticle of the foot, called horn or hoof, is more dense than the cuticle covering the body. It is composed of exactly the same cellular elements, as can be proved by even a tyro in the use of the microscope by the easy method of cutting a very thin slice of hoof horn, soaking it in a solution of potash for a short time, and then examining the preparation with a moderate magnifying power. A portion of cuticle from any part of the skin treated in the same way will exhibit the same appearance, viz., those of Fig. 5.

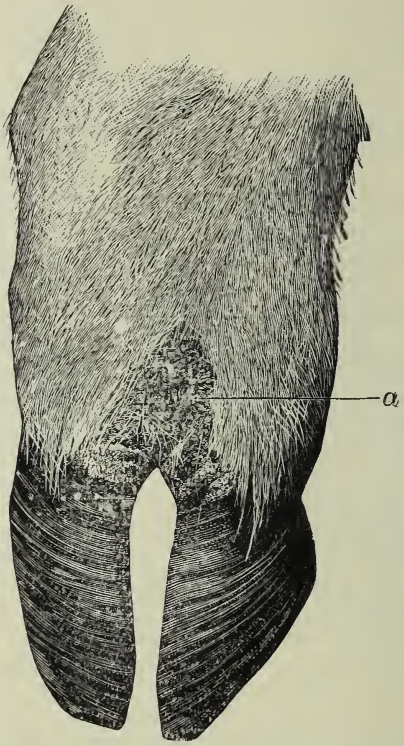

Fig. 3.—Foot of sheep showing early stage of disease affecting the skin between the claws.

SYMPTOMS OF CONTAGIOUS FOOT ROT.

In the event of any circumstance, such as the return of sheep after being exposed in a public market or the introduction of fresh sheep, giving rise to a suspicion of the infection of foot rot, steps should be taken to insure the detection of the earliest indications of the disease in the flock.

It is most important for the cure and prevention of foot rot to be able to detect it in the early stage without any risk of error, and at the outset the disease can be distinguished from all forms of foot disease of the sheep with ease and certainty. If the skin between the diseased hoofs is looked at, a little moisture or white discharge with very minute pimples covering the skin will be seen. In Fig. 3 this condition is shown. Later

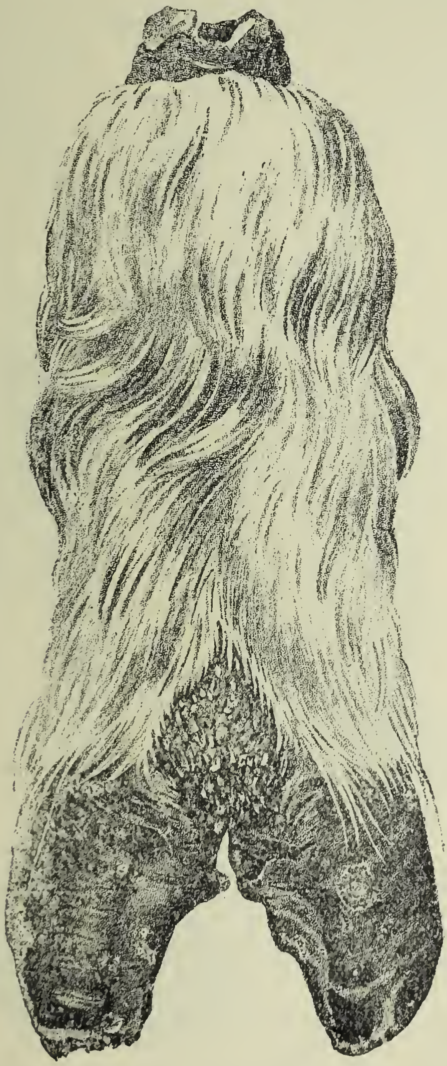

FIG. 4—More advanced form of disease of skin between the claws.

on, as the disease of the skin advances, the whole surface may be covered with elongated warty growths, as seen in Fig. 4. In most instances the inflammation extends to the inner side of the internal structures of one claw, and the hoof becomes disconnected from its membrane, which is soon covered with long fungoid growths, as they are called—in reality, horny fibres, or epithelial growths of a warty kind. The whole product is, indeed, a mass of epithelial cells, as shown in Fig. 5. When the disease runs its course unchecked, the horn of the diseased claw is loosened from the inner surface and in a short time is entirely pushed off, and a new hoof begins to grow from the coronet downwards. Fig. 6 shows this change. If the hoof is not thrown off quickly, it grows with rapidity and is more or less distorted in form, as seen in Fig. 7. The horny tufts sprouting from the diseased membrane are seen distinctly in Figs. 6 and 7 ; and in the next illustration (Fig. 8) a small portion of the diseased membrane has been hardened and cut into fine sections, one of which is shown, exhibiting very distinct horn structure.

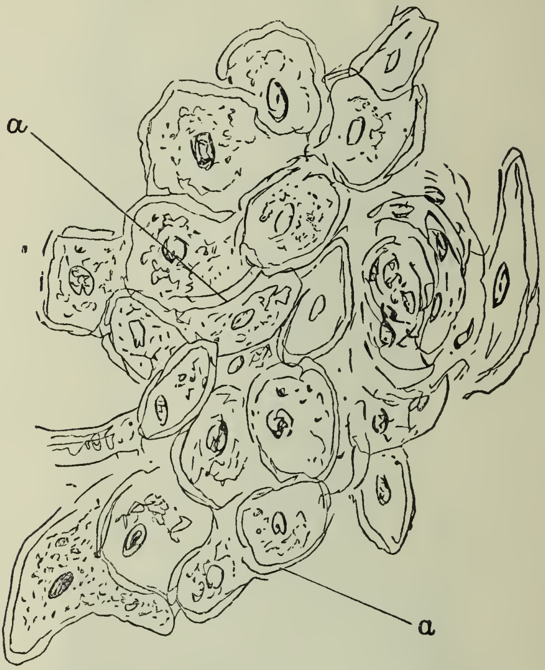

FIG. 5.—Scraping from fungoid growths. *a, a*, Epithelial or horn cells, magnified 200 diam.

In reference to the changes which are illustrated in the last three drawings, it may again be remarked that similar changes are seen in other inflammatory diseases of the foot of the sheep, also in foul in the foot of the ox, and in canker in the foot of the horse. It is therefore necessary to lay stress on the

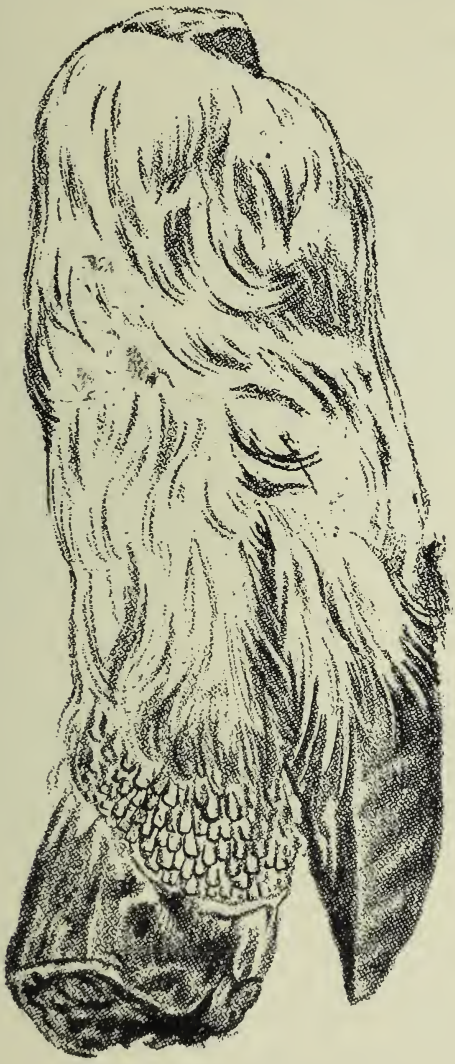

FIG. 6.—Foot rot in an advanced form ; the secreting membrane is covered with fungoid growths.

statement that the really definite signs of contagious foot rot are most perfectly seen in the earlier stages of the disease. Indeed, it cannot be too strongly urged that most reliable signs are exhibited in the incipient form.

EXPERIMENTS TO TEST THE CONTAGIOUS CHARACTER OF FOOT ROT.

In 1867, at the instigation of the members of the Maidstone Farmers' Club, who sent cases of foot rot to the Royal Veterinary College for the purpose, an investigation was carried on for twelve months, and the results were sufficiently definite to justify the conclusion that the disease can be produced by contact with an infected animal, and also by the application of the discharge from a diseased foot to the skin between the digits. Inoculation with the discharges by puncturing the skin, and in other cases by removing a small portion of the hoof of a healthy foot and applying the matter to the exposed secreting surface, was generally followed by healing of the injured part; but some days afterwards the skin between the digits became moist and swollen, and the early stage of foot rot was developed, but did not advance beyond that stage, although no means were taken to check it.

Fifteen years ago (1890) the question of the contagious nature of foot rot was raised in a communication to the Society from Mr. Nott, of Tenbury,[1] who contended that the disease is only produced by means of contact with a diseased sheep, and that the only certain method of prevention is to avoid the introduction of fresh sheep on to a farm.

Mr. Nott sent two sheep to the Royal Veterinary College for the purpose of experiment in the beginning of April, 1890. The animals did not show any signs of foot rot; indeed, their feet were perfectly healthy, but from the circumstances of their history it was believed that the disease would appear if the sheep were placed under favourable conditions. Accordingly, they were penned on a pasture on a clay soil, and the want of rain was as far as possible compensated by constantly watering the ground. Two healthy sheep were put in the same pen with these sheep, and kept with them till the end of the third week in June without any result. All four sheep remained free from disease.

On November 11 of the same year a well defined case of foot rot was obtained and sent to the College, where it was put on grass with two perfectly healthy sheep. After about three weeks' exposure both the sheep became lame in one hind foot. The diseased sheep was much worse. Association of the animals was maintained until the middle of February, 1891, when the disease had practically ceased to exist. The diseased sheep and those in contact had recovered, and were perfectly sound. It is worthy of remark that during the whole time that this experiment was carried on the weather was generally dry.

---

[1] Journal R.A.S.E., Vol. 51, 1890, page 733.

FURTHER EXPERIMENTS AT HARROW AND DENHAM.

In the early part of 1891 further experiments were conducted at Harrow and at Denham on a much larger scale than any which had been attempted previously. In the Harrow district, on the lower grounds particularly, the soil is stiff clay, and the difficulty was to find a pasture which had not become contaminated. At last an orchard was secured on which no sheep had been grazed certainly for many years past, and two diseased sheep from the neighbourhood of Maidstone, which were sent by Mr. C. Whitehead, were used for the experiment. Foot rot in these animals was fully developed in a perfectly typical form.

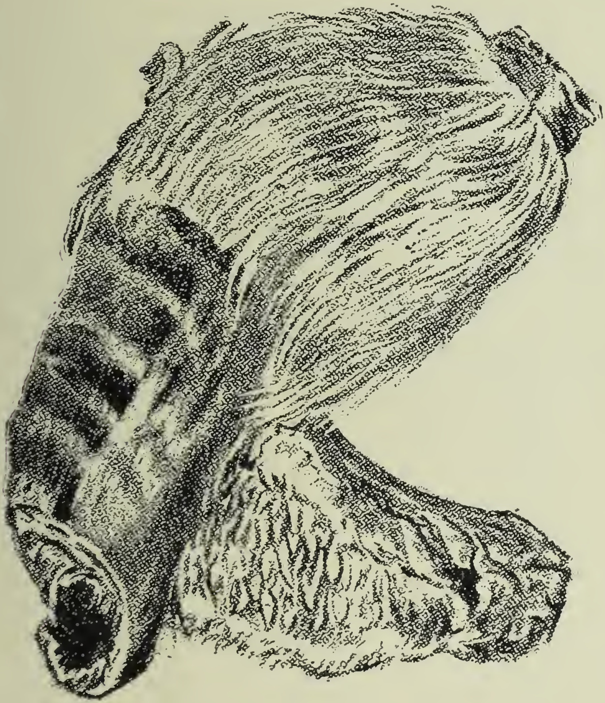

FIG. 7. Distortion of hoof in an advanced form of foot rot.

In the pasture at Harrow three pens were constructed. In No. 1 pen in the first week in April were placed the two diseased

Kentish ewes, one sound Welsh sheep, and three sound tegs; whilst in No. 2 pen were placed two half-bred tegs, and in No. 3 pen two Welsh ewes.

Owing to the absence of rain the experimental pasture was in a very dry condition until the last week of May. During this period the sheep's feet were frequently examined and nothing was found amiss with them, but rain having fallen for several days in succession towards the end of May the pasture became thoroughly soaked, and almost immediately afterwards signs of foot rot were apparent.

On June 2 the Welsh ewe in No. 1 pen was noticed to be lame on its left front foot. On the following day it was caught and the foot examined, when it was observed that the skin of the interdigital space was much inflamed, and that suppuration existed at the upper border of both claws at the interdigital space, whilst the leg immediately above the hoof was swollen and very hot. The left hind foot of this sheep was very hot, and on June 4 the disease had developed in this foot also.

On June 3 one of the tegs in pen No. 1 showed unmistakable symptoms of foot rot in its right hind foot, but lameness was not marked until the next day; on this date also another of the tegs became lame. The remaining teg in this pen did not become affected until two months later, namely, on August 2, when the pasture was again very wet. Two of these experimentally affected sheep had the disease in three of their feet, whilst in one it appeared in one foot only. During all this period of time the four sheep which had meanwhile been kept in pens Nos. 2 and 3 under precisely similar conditions as the sheep in pen No. 1, except that they had not been in contact with affected animals, continued sound.

One of the Kent ewes and the Welsh ewe in pen No. 1 lambed in May, each having one lamb, sound and well nourished. On August 8 the Kentish lamb which remained from its birth in the pen had foot rot in the off fore foot, and by August 16 all the feet were attacked.

On August 31 the sheep from pen No. 1 were placed on another pasture (seven acres); and on September 2 the two sound tegs from No. 2 pen, and a Welsh ewe from No. 3 pen (also sound), were put into No. 1 pen, from which the affected animals had been removed two days previously. On September 13 this Welsh ewe had foot rot in both her front feet; on September 19 one of the tegs had also become affected. On September 19 a Cotswold wether and a cross-bred lamb (both sound) were sent from Denham, and were placed in the seven-acre pasture with the eight sheep out of pen No. 1. On September 23 all the sheep were placed in this pasture, with the exception of one Welsh ewe, which had never been removed from pen No. 3, and was still sound. On October 2 the remaining teg[1] became affected in her right hind foot. On October 9 the cross-bred lamb from Denham had foot rot in her off hind foot, and on October 11 the Cotswold wether had the disease, and was very lame in his right fore foot; while on October 18 both of the Denham sheep had the disease in two of their feet.

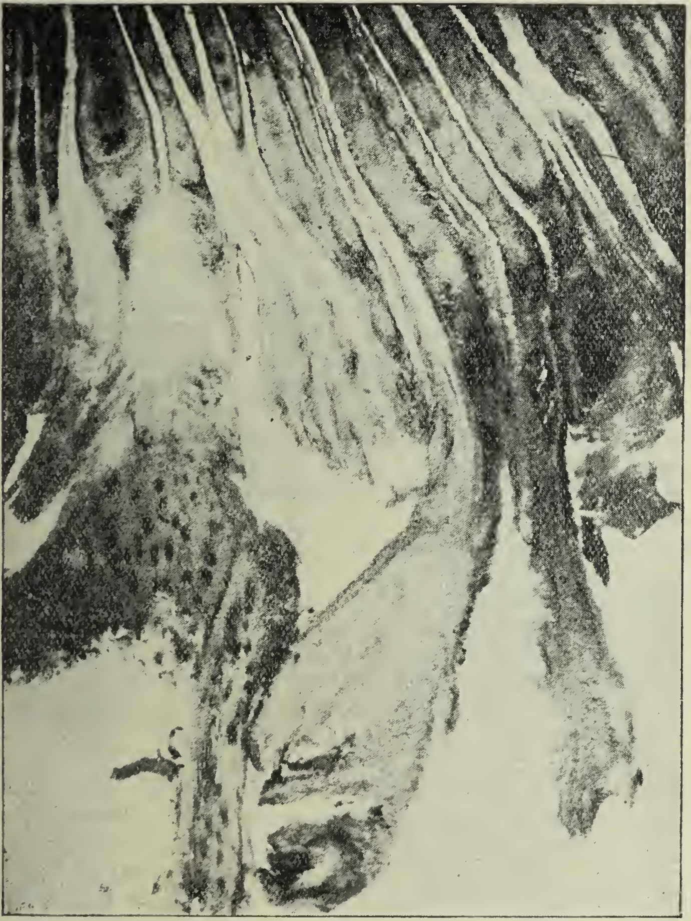

FIG. 8.—Section of fungoid growths, horn fibres.

---

[1] *i.e.*, Remaining teg from No. 2.

Up to October 12 the Welsh ewe, which remained still isolated in pen No. 3, was healthy, although the ground was extremely wet and the grass long; the Welsh lamb also continued healthy.

At the end of October the interest of the experiments was practically confined to the condition of the Welsh ewe, which had been isolated since the commencement of the work, and to the two sheep from Denham. The Welsh ewe had been removed on October 4 to pen No. 2. This was a healthy pen lying very low. By October 25 it was a "quagmire." On November 8 this sheep had sores at the interdigital spaces of all four feet, due to irritation by foreign matter (mud, hay-bents, &c.), and was particularly lame on the right fore foot, but not from foot rot. On November 14 it had still sores on all four feet, and there was loss of hair on the coronets, heels, and legs as high up as the mud extended; the interdigital spaces of all four feet still presented sores. This condition might be described as "foul in the foot" or "mud fever." The sheep was turned into the seven-acre field with the other sheep on November 14. It did not up to the date of its slaughter on February 9 develop foot rot.

On November 8 the wether from Denham had foot rot very badly in the left hind foot; the soles of both claws of this foot were "separated," and there was suppuration at the interdigital space. The right hind foot was nearly well. But the disease existed slightly in both front feet.

On November 8 the Denham lamb had foot rot very badly in the left hind foot. The right hind foot was better. It had also foot rot slightly in the right hind foot.

The Kentish lamb, which had suffered terribly from the disease, having had it in all four feet, had new claws growing down from the coronet of the outside digit of three of its feet.

On November 14 both Denham sheep were greatly improved; all the sheep were then in the seven-acre pasture, and improved in condition for about a month, some of them getting quite fat; but on December 20 several of them again were extremely lame. This lameness appeared in a great measure to be due to the hardness of the ground, which was frozen, and to the overgrown and deformed condition of the feet. On January 11 (1892) the Denham lamb, which was very lame and lay about a good deal, was killed, and the feet retained as specimens. No sign of foot rot was found on examination. On January 26 the feet of the speckled-faced teg and of the Kentish lamb were found to be deformed, but were free from foot rot.

On February 9 the remaining sheep were killed. All were free from foot rot.

A fourth series of experiments was carried on at the same time at Denham, where an outbreak of foot rot afforded a most convenient opportunity for an investigation.

July 23, 1891.—Five Cotswold tegs and five half-bred lambs were obtained from a hill farm at Cirencester (where, during the last seventeen years, there had never been a case of foot rot, and prior to that, so far as could be ascertained, foot rot had never been known on the farm). These sheep were arranged as follows :—

Pen A, in a barn on concrete floor.—One sound teg with one Southdown ewe with foot rot.

Pen B, same as above.—One sound lamb with one diseased lamb (foot rot). These concrete floors were swept out clean every morning during the experiment. The pens were eight feet by seven feet six inches.

In Orchard, running loose. (The orchard is a dry and well-drained meadow.)—One sound teg and one sound lamb with one diseased ewe and one diseased lamb.

On grazing meadow.—At first penned by side of stream, and afterwards with range of whole meadow. (This is a very damp low-lying meadow almost surrounded by water, where sheep are never kept.) Three sound tegs and three sound lambs were placed to be left for a considerable time to test the action of damp soil and long coarse grass on the feet.

August 3.—All the above were examined. The sound sheep remained sound, and the diseased sheep were still diseased, although a little better.

September 12.—Second examination, with result as follows:—

Pen A, in barn.—Sound teg still sound; diseased ewe very bad in all four feet.

Pen B, in ditto.—Sound lamb still sound; diseased lamb nearly well.

Orchard.—Sound sheep and lamb still sound; diseased ditto much better.

Note.—On September 17 one teg and one lamb, both quite sound, from grazing meadow, were sent to Harrow and put on the pasture with diseased sheep, and both of them became affected; on October 9 the lamb, and on October 10 the teg, the lamb in the off hind foot, the teg in the off fore foot.

October 6.—Third examination :—

Pen A.—The sound teg had developed the disease in all four feet as the result of being in contact with the Southdown ewe with foot rot since June 25 on a hard floor which was kept as clean as possible.

A similar result occurred in *Pen B*, in which the sound lamb had developed the disease in the off fore foot, the diseased lamb still remaining diseased.

In the *Orchard* the sound teg had developed the early stage of foot rot in the off fore foot and both hind feet, the sound lamb showing disease very slightly in the off hind foot. Diseased ewe and lamb much better.

October 10, *Pens A and B.*—Disease becoming more developed in teg and lamb formerly sound ; the ewe and lamb originally diseased are recovering.

Sheep and lambs on grazing meadow.—These were thoroughly examined on this day, and their feet were found in perfect order notwithstanding the long exposure to wet ground, long grass, and exceptionally wet weather.

October 12.—Two lambs from Pen B were sent to the Veterinary College, and the diseased ewe in Pen A was ordered to be killed and the feet sent to the College. The teg which had contracted the disease was to be put in fresh pen (C), where no sheep had been before, with one sound teg and one sound lamb from grazing meadow. The floor was to be kept thoroughly cleansed.

October 24, *Pen C.*—Teg and lamb free from any sign of disease, except that the lamb's feet were warm. Diseased teg remained in the same condition as when put into the pen.

November 5, *Orchard.*—Cotswold teg in orchard killed. Feet sent to College ; perfectly sound.

November 7, *Pen C.*—Diseased teg better, removed to another pen. Teg and lamb from grazing meadow still sound. Sound teg and lamb left in Pen C, to observe if disease would appear from contact with the diseased teg from October 12 to November 7.

November 12, *Orchard.*—Cross-bred lamb killed. Feet sent to College ; quite recovered.

November 19, *Orchard.*—Southdown lamb killed. Feet sent to College ; found to be free from disease.

November 27, *Orchard.*—Southdown ewe killed. Feet sent to College ; found to be free from disease.

November 28, *Pen C.*—Teg showed redness and swelling on inside digit of the off hind foot. Lamb had the off hind hoof ragged at the toe.

December 4, *Grazing meadow.*—The teg still remained sound ; killed, and the feet sent to the College. No sign of disease after exposure to wet soil since June.

December 21.—Four sheep now remained at Denham, two tegs and two lambs from Cirencester (Cotswolds). One teg with foot rot left in a pen by itself. A teg and lamb remained in Pen C.

January 2, 1892, *Pen C, teg and lamb.*—Teg remained free from disease. Lamb, off fore hoof ragged at bottom ; off hind foot, horny growth above digits ; slight evidence of foot rot.

Diseased teg in pen by itself had the off hind hoof still bad: off fore foot, rotten sole: near fore foot, better. Little paddock, the lamb (from grazing meadow) had the hoofs a little cracked at bottom; no sign of foot rot.

April 2, *Pen A.*—Foot perfectly recovered. April 26, killed; sound.

Pen C.—Teg and lamb quite sound.

April 22.—Both killed, feet sound. Lamb from grazing meadow now on cricket ground, where foot rot prevailed last summer: sound yet.

May 25.—This animal had been running with several sheep affected with chronic foot rot since last summer, but did not yet show any signs of disease.

CONCLUSIONS FROM THE EXPERIMENTS.

From the experiments the following conclusions may be drawn:—

(1) Researches extending over a long period justify the statement that foot rot is a contagious disease; the infective matter being most active when brought in contact with the skin between the claws, or when introduced into the system by inoculation, and probably when taken in by the mouth from contaminated pastures.

(2) Foot rot cannot be produced by keeping sheep on undrained moist soils with an abundant coarse and wet herbage, or on wet and rotten litter and manure.

(3) Animals exposed to these conditions for many months, and resisting entirely the influences named above, contracted foot rot in from fourteen to twenty-one days on being placed among sheep suffering from the disease.

(4) Sheep affected with foot rot may improve, and from time to time become worse; and finally may recover and present a perfectly healthy condition of foot, notwithstanding that they have been kept the whole period under the conditions which would be expected to favour the continuance of the disease.

(5) The contagium of foot rot may remain for some time in the system (ten to twenty days and longer) without any indication of disease appearing in the skin between the claws. An infected sheep may therefore escape detection even by an expert, and may introduce foot rot into a sound flock.

The possibility of sheep contracting foot rot by taking the infective matter into the system during feeding on an infected pasture must of course be admitted, as on land on which sheep affected with foot rot are grazing a very large amount of infective material must be distributed, and consequently taken up by all the animals feeding on the meadow; but it is not easy to determine whether the disease is so communicated, or by contact of the infective matter with skin between the claws.

In order to bring our knowledge of the cause or causes of foot rot up to date, further inquiry, it has been suggested, is necessary, and it cannot be denied that the chain of evidence in the case of this, as in that of many other infective diseases, is wanting in an important link; the specific cause has not been discovered. Experiments extending over many years have proved that the true contagious foot rot cannot be originated without the intervention, direct or indirect, of a sheep affected with the disease, and it is a reasonable assumption that the specific cause of the malady is a micro-organism. The very natural query arises, Why have no efforts been made by bacteriologists to isolate the particular microbe? The answer is that the investigation is beset with difficulties, and even in the barely possible event of success very unpromising. It is true that in the matter obtainable from the diseased parts microbes are abundant enough and can be cultivated readily by the ordinary methods; but among the millions of organisms, to select one after another, cultivate until a certain number of microbes are obtained in a pure state, and test them on sheep, means an amount of labour not to be lightly undertaken, especially as after the work was finished and the microbe of foot rot isolated, it would still be necessary, in order to prevent an outbreak of foot rot, to keep healthy sheep from direct or indirect contact with the infective material. It is presumed that no practical man would entertain the idea of rendering his flock immune by inoculation with foot rot vaccine.

CURE AND PREVENTION OF FOOT ROT.

One important fact has stood prominently forward in the history of the experiments—*i.e.*, spontaneous recovery even in the most advanced stages of foot rot without any trimming of the hoof, the use of any remedial measures, or the removal of the diseased animals from the places where they were kept during the progress of the disease. It is, on the other hand, to be remembered that the recovery is much assisted by proper remedies. So far as the evidence at present extends, it may be said that contagious foot rot has a period of incubation, followed by the development of a diseased condition of the skin, which extends to the secreting membrane of the internal foot, ending in loss of the hoof, and a new growth of horn when the virulence of the malady is exhausted.

Treatment of foot rot.—In order that the course of the disease may be checked, timely detection is essential, and when foot rot appears in a flock every sheep should be examined daily if possible, or at least three times a week, and a dressing applied the moment that any moisture is seen between the claws. A mixture of one part of pure carbolic acid with ten parts of glycerine is a very useful application, a little of which may be *poured* from a narrow-mouth bottle on to the skin and allowed to run between the claws.

Trimming the diseased feet is an operation which should be done with care ; as a rule, the shepherd slashes the hoof horn away with his knife in a manner which may be described as brutal. In the advanced stages of the disease all the loose horn may be removed, and the club-like growths beneath it should be dressed with strong caustic—*i.e.*, pure carbolic acid, chloride of zinc, or perchloride of iron—and the parts protected by a coating of tar. But in a properly managed flock the disease should not be allowed to reach a stage at which such severe measures are necessary.

An easy method of dealing with foot rot in a large flock without the work of daily examination of the feet is to drive the sheep twice a week over a dry floor which is covered with powdered lime, or through a trough containing a solution of one part of carbolic acid with fifty parts of water in which a little soft soap is dissolved. Sufficient fluid should be kept in the trough to insure that the feet are completely covered.

Prevention of foot rot.—It has been suggested that the only certain way to escape the introduction of foot rot is to avoid bringing fresh sheep on to the farm, and there cannot be a doubt that the method is at once simple and effectual.

It is not, however, likely that the generality of farmers will be able to follow such a plan, and without such a radical change in the present system a great deal might be done which is now neglected, and will continue to be neglected until the dictum quoted in the introduction, to the effect that a shepherd has no right to have foot rot in the flock, becomes ingrained in the shepherd's mind, and prompts him, instead of waiting for lame sheep, to examine his flock regularly and, on noting the least appearance of an eruption on the skin covering the space between the claws, at once to have the whole flock put through the trough or bath containing any of the preparations which have been named. Under such a system as this, foot rot, as we know it, would soon become a thing of the past.

From long usage the shepherd has come to be looked upon as the sole manager competent to render all assistance—veterinary included—which the flock may require, and he might at least do, or see done, certain things which are often left undone; for instance, sheep from any fair or market, or from any source not quite free from suspicion, might be kept by themselves for a month and not then released until their feet had been carefully examined and found free from any signs of foot rot. If the newly purchased sheep are kept separate from the rest of the flock for a month and remain healthy, there will be but little risk of an outbreak of the disease. Sheep which have been sent from the farm to a market and brought back again should be dealt with in the same manner as if they had been bought at the market.

The question of including foot rot among the diseases which come under the provisions of the Diseases of Animals Acts may have to be considered in the future. But for the present the farmer will consult his own and his neighbours' interests by acting for himself without waiting for the compulsion of the law.

PRINTED BY JAS. TRUSCOTT & SON, LTD., SUFFOLK LANE, LONDON.

SEVENTH EDITION
(THIRTIETH THOUSAND)
OF

Elements of Agriculture

A TEXT-BOOK

PREPARED UNDER THE AUTHORITY OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

By W. FREAM, LL.D.

CONTENTS.

PART I.—THE SOIL.

1. Origin and Properties of Soils.
2. Composition and Classification of Soils.
3. Sources of Loss and of Gain to Soils.
4. Moisture in Soils.
5. Improvement of Soils.
6. Tillage.
7. Implements for Working Soils.
8. Manures and Manuring.

PART II.—THE PLANT.

9. Seeds and their Germination.
10. Structure and Functions of Plants.
11. Cultivated Plants.
12. Weeds.
13. Selection of Seeds.
14. Implements for Securing Crops.
15. Grass Land and its Management.
16. Farm Crops.
17. Fungus Pests.
18. Insect Pests.

PART III.—THE ANIMAL.

19. Structure and Functions of Farm Animals.
20. Composition of the Animal Body.
21. Foods and Feeding.
22. The Art of Breeding.
23. Horses: their Breeds, Feeding, and Management.
24. Cattle: their Breeds, Feeding, and Management.
25. Sheep: their Breeds, Feeding, and Management.
26. Pigs: their Breeds, Feeding, and Management.
27. The Fattening of Cattle, Sheep, and Pigs.
28. Dairying.

Index of Plants.
General Index.

Of all Booksellers.

486 PAGES, WITH 256 ILLUSTRATIONS.

Price THREE SHILLINGS AND SIXPENCE, bound in cloth.

LONDON: JOHN MURRAY, 50A ALBEMARLE STREET, W.

3 0112 077315106

PUBLICATIONS OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

JOURNAL OF THE SOCIETY.

Now published annually as a Bound Volume of about 600 pages. Free to Members; Price to Non-Members, Twelve Shillings.

TEXT-BOOK ON AGRICULTURE.

ELEMENTS OF AGRICULTURE: a Text-book prepared under the authority of the Royal Agricultural Society of England by W. FREAM, LL.D. 486 pp. with 256 Illustrations. Seventh Edition (30th Thousand) 1902. Price 3*s.* 6*d.*, bound in cloth.

FARM ACCOUNT BOOKS.

No. 1, A DIARY, combining Cash Account with daily record of Farm Transactions. Price 4*s.*

No. 2, A FARM ACCOUNT BOOK, showing payments and receipts, and supplying a form of Annual Balance Sheet. Price 5*s.* 6*d.* Published for the Society and sold by Messrs. FORSTER, GROOM & CO., Ltd., 15 Charing Cross, London, S.W.

PAMPHLETS.

VETERINARY PAMPHLETS BY PROFESSOR SIR GEORGE BROWN, C.B.:

DENTITION AS INDICATIVE OF THE AGE OF FARM ANIMALS. Fifth Edition (1902). 64 pp. With 60 Illustrations. Price 1*s.*

ANIMALS OF THE FARM IN HEALTH AND DISEASE. 72 pp. With 52 Illustrations. Third Edition (1895). Price 1*s.*

THE STRUCTURE OF THE HORSE'S FOOT AND THE PRINCIPLES OF SHOEING. 24 pp. Fourth and Enlarged Edition (1902). With 12 Illustrations. Price 6*d.*

CONTAGIOUS FOOT ROT OF SHEEP. 2nd Edition (1905). 24 pp. With 8 Illustrations. Price 1*s.*

OTHER VETERINARY PAMPHLETS:

THE MARE AND FOAL. By Professor J. WORTLEY AXE, M.R.C.V.S. 58 pp. With 20 Illustrations (1898). Price 1*s.*

THE LAMBING PEN. By HAROLD LEENEY. 3rd Ed. (1897). With 9 Illustrations. Price 6*d.*

PAMPHLETS BY MR. CHARLES WHITEHEAD, F.L.S., F.G.S.:

PRACTICAL HINTS ON FRUIT FARMING. (1904). With 10 Illustrations. 44 pp. Price 1*s.*

HOP CULTIVATION. With 13 Illustrations (1893). 48 pp. Price 1*s.*

DAIRY PAMPHLETS:

(Issued under the authority of the Dairy Committee of the Society.)

THE PRACTICE OF (a) CHEDDAR, (b) CHESHIRE, AND (c) STILTON CHEESE-MAKING. Price 2*d.* each.

SIMPLE RULES FOR BUTTER-MAKING. Revised May, 1896. (Sheet.) Price 1*d.* each or 5*s.* per 100. Mounted on card and varnished, to hang up in the Dairy, 6*d.* each.

(These Rules can also be had in the Welsh Language.)

OTHER PAMPHLETS:

THE VALUATION OF UNEXHAUSTED MANURES OBTAINED BY THE CONSUMPTION OF FOODS BY STOCK. By J. AUGUSTUS VOELCKER, M.A., B.Sc., Ph.D., and A. D. HALL, M.A. With 3 Diagrams (1903). 44 pp. Price 1*s.*

PRACTICAL HINTS ON VEGETABLE FARMING. By JAMES UDALE. (1904.) With 15 Illustrations. 42 pp. Price 1*s.*

TABLES FOR ESTIMATING DEAD WEIGHT AND VALUE OF CATTLE FROM LIVE WEIGHT. By the late Sir JOHN B. LAWES, Bart., F.R.S. Price 1*s.*

THE WOBURN EXPERIMENTAL STATION OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND. By J. AUGUSTUS VOELCKER, M.A., B.Sc., Ph.D. Reports on Field, Feeding and Pot-Culture Experiments (1899–1902). With 27 Illustrations (1902). 88 pp. Price 1*s.* With 7 Illustrations (1903). 56 pp. Price 1*s.* With 13 Illustrations (1904). 40 pp. Price 1*s.*

REPORT ON THE WOBURN POT-CULTURE STATION. By J. AUGUSTUS VOELCKER, M.A., B.Sc., Ph.D. With 17 Illustrations (1900). 52 pp. Price 2*s.* 6*d.*

THE MAKING OF THE LAND IN ENGLAND. By ALBERT PELL. (1899.) 27 pp. Price 6*d.*

THE MANAGEMENT AND PLANTING OF BRITISH WOODLANDS. By Professor CHARLES E. CURTIS, F.S.I. (1904). With 6 Illustrations. 36 pp. Price 1*s.*

THE CONVERSION OF HOME-GROWN TIMBER. By ROBERT ANDERSON, F.S.I. (1904). With 4 Illustrations. 28 pp. Price 1*s.*

INSECTS INJURIOUS TO FOREST TREES. By CECIL WARBURTON, M.A., F.Z.S. (1904). With 7 Illustrations. 16 pp. Price 1*s.*

ORCHARD AND BUSH-FRUIT PESTS AND HOW TO COMBAT THEM. By CECIL WARBURTON, M.A., F.Z.S. With 12 Illustrations (1902). 20 pp. Price 6*d.*

THE DRYING OF FRUIT AND VEGETABLES. By J. AUGUSTUS VOELCKER, M.A., B.Sc., Ph.D. With 4 Illustrations (1897). 24 pp. Price 3*d.*

HEDGES AND HEDGE-MAKING. By W. J. MALDEN. With 10 Illustrations (1899). 32 pp. Price 6*d.*

COTTAGE SANITATION IN RURAL DISTRICTS. By H. MACLEAN WILSON, M.D., B.Sc. With a Preface by T. PRIDGIN TEALE, F.R.S. New and Enlarged Edition. 32 pp. 12 Illustrations (1896). Price 3*d.* per copy; 2*s.* per doz.; 12*s.* 6*d.* per 100.

THE AGRICULTURAL HOLDINGS ACT, 1900. By S. B. L. DRUCE. Second and Enlarged Edition (1901). 38 pp. Price 6*d.*

The above can be obtained at the Society's House, 13 Hanover Square, London, W.; through any bookseller, or of Mr. JOHN MURRAY, 50a Albemarle Street, W. Copies of pamphlets sold at not less than One Shilling each are obtainable by Members of the Society at half-price on direct application to the Secretary.

COLOURED DIAGRAMS.

(Obtainable from Messrs. W. & A. K. Johnston, Limited, 7 Paternoster Square, E.C., and Edinburgh.)

DIAGRAMS OF INJURIOUS INSECTS. Drawn from Nature by the late Miss GEORGIANA E. ORMEROD, in conjunction with the late Miss ELEANOR A. ORMEROD, F.R.Met.Soc. Price 1*s.* 6*d.* each. Varnished and mounted on canvas, with rollers, 2*s.* 6*d.*

EIGHT DIAGRAMS REPRESENTING THE LIFE-HISTORY OF THE WHEAT PLANT (after FRANCIS BAUER). With Explanatory Pamphlet by W. CARRUTHERS, F.R.S., Consulting Botanist to the Society. Price (including Pamphlet) 10*s.* per Set of Eight Diagrams.

THE POTATO DISEASE. By W. CARRUTHERS, F.R.S., Consulting Botanist to the Society. Price 1*s.*